

Quantum Numbers

Atomic Orbital

- A solution to Schrödinger's wave equation.
- The _____ of space where an electron spends _____ of its time.
- Can be described as an "electron cloud".
- Each orbital has a specific energy level, or shell.

Quantum Numbers

- Integer values that arise from the Schrödinger equation.
 - Three of which describe the _____ of electrons in the atom,
 - One that describes the _____ of a given electron in the atom.

1. The _____ (n):

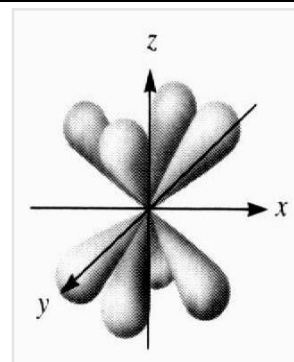
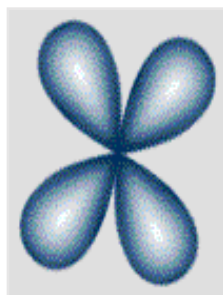
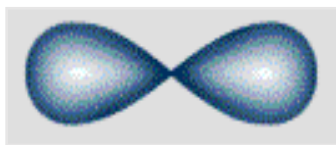
- Indicates the main energy level in which the electron is found.
- Indicates the size of the orbital.
- Allowed values: $n = 1$ to infinity.

2. The _____ (l):

- Indicates the energy sublevels in which the electron is found.
- It describes the orbital's shape.
- Allowed values = 0 to $(n-1)$ [dependent on the principal quantum number]
 - If $n = 1$, then $l = 0$.
 - If $n = 2$, then l can be either 0 or 1. [Tells us about the number of sublevels]
 - If $n = 3$ then l can be either 0, 1, or 2.
- Particular values of l are identified by a specific letter:

l	0	1	2	3
Orbital name	s	p	d	f

- The shapes themselves are as follows:



- Electrons can have the _____ l value, but it does not mean that they occupy the same orbital given that the orbital may have an _____.
- To identify an energy sublevel, combination the principal quantum number with the angular movement
 - A sublevel with $n = 3$ and $l = 0$ is called _____.
 - A sublevel with $n = 2$ and $l = 1$ is called a _____.

3. The Magnetic Quantum Number (m_l)

- Indicates the _____ of the orbital around the nucleus.
- Specifies the exact orbital within each _____.
- Allowed values: _____.
 - If $l = 0$, then $m_l =$
 - If $l = 1$, then m_l can be either: -1, 0, or 1.
 - If $l = 2$, then m_l can be either: -2, -1, 0, 1, or 2.
- There are exactly $2l + 1$ values of m_l .

4. The _____ (m_s)

- Specifies the direction of the electron spin: either _____ or _____.
- Note that an orbital can only hold 2 electrons of opposite spin.

Exercise

1. What are the possible quantum numbers for the first energy level
 - a. Value of the first quantum number (n)?
 - b. Possible values of the second quantum number (l)?
 - c. Possible values of the third quantum number (m_l)?
 - d. Possible values of the fourth quantum number (m_s)?

2. What are the possible quantum numbers for the second energy level
 - a. Value of the first quantum number (n)?
 - b. Possible values of the second quantum number (l)?
 - c. Possible values of the third quantum number (m_l)?

 - d. Possible values of the fourth quantum number (m_s)?

3. How many electrons it is possible to find:
 - a. In all of the $n = 2$ orbitals?

 - b. If we are given the quantum numbers $n = 2$ and $l = 1$?

 - c. All of the p orbitals?